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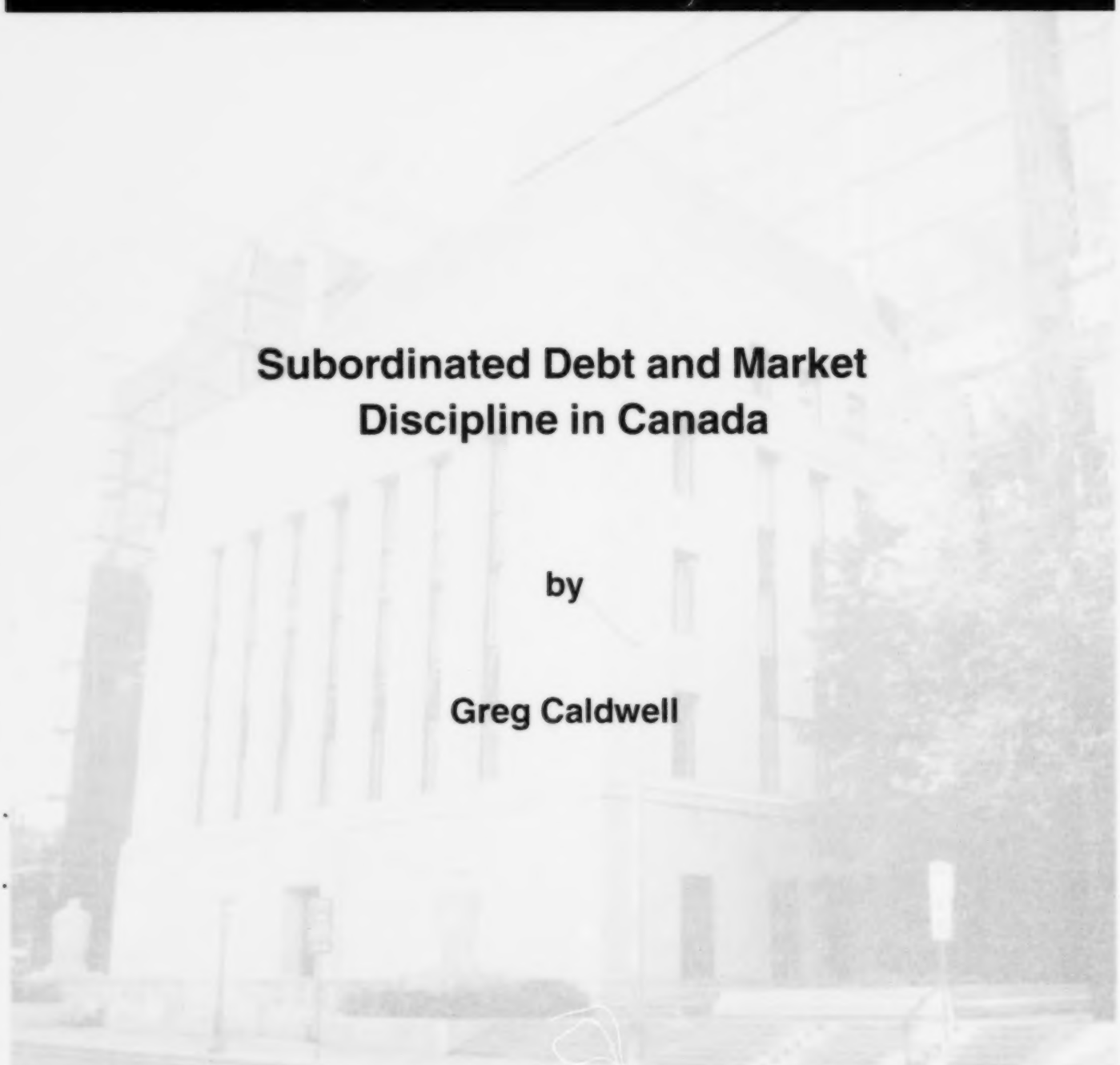
Subordinated Debt and Market Discipline in Canada

by

Greg Caldwell



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The views expressed in this paper are those of the author.
No responsibility for them should be attributed to the Bank of Canada.

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Abstract

The author documents the use by Canadian banks of subordinated debt (SD) as a capital instrument. He reviews the economic benefits of this asset as a mechanism for market discipline and highlights academic and policy research over the past 20 years. The author provides both qualitative and quantitative summaries of the current regulatory and market environment in Canada, and conducts a Tobit analysis of factors that affect a bank's decision to issue SD. He also constructs a cross-section time-series sample of banks, into which controls for fixed effects, along with other non-default risk factors, are incorporated. Results for domestic banks show that, whenever there exists a high degree of gross impaired non-mortgage loans and mortgage writeoffs relative to assets, banks are less likely to issue SD. In contrast, increases in past-due (but still unimpaired) non-mortgage loans have a positive effect on SD issuance. This suggests that domestic banks 'time' their issuance decisions to avoid market discipline.

JEL classification: G21, G28
Bank classification: Financial institutions

Résumé

L'auteur se penche sur le recours des banques canadiennes à l'émission de titres de dette subordonnée. Il examine les avantages économiques de cet actif comme outil de discipline de marché, et met en relief les travaux réalisés par des universitaires et des banques centrales depuis 20 ans. Il brosse un panorama qualitatif et quantitatif du cadre réglementaire et des conditions de marché actuels au Canada. L'auteur effectue une analyse Tobit des facteurs qui influencent la décision d'une banque d'émettre des titres de dette subordonnée. Il constitue pour cela un échantillon longitudinal composé de banques et intègre à son modèle des effets fixes ainsi que des facteurs non liés au risque de défaillance. D'après les résultats qu'il obtient, les banques canadiennes sont moins enclines à émettre des titres de dette subordonnée lorsque l'encours de leurs prêts douteux bruts non hypothécaires et le montant des radiations d'effets hypothécaires sont élevés comparativement aux actifs. En revanche, un accroissement du montant des prêts non hypothécaires en souffrance mais qui ne sont pas encore jugés douteux s'accompagne d'une hausse des émissions. Cela donne à penser que les banques canadiennes choisissent le moment de leurs émissions de manière à échapper à la discipline de marché.

Classification JEL : G21, G28
Classification de la Banque : Institutions financières

1. Introduction

The purpose of this paper is to develop a better understanding of the usage (and usefulness) of subordinated debt (SD) in Canada as a tool for the market discipline of banks. Subordinated notes and debentures are fixed-income instruments that are unsecured and senior only to common equity, in the event of bankruptcy. These last two characteristics make SD a good candidate for rendering market discipline on the bank. The concept of market discipline, in the context of bank supervision, involves market prices acting as a mitigating force on a bank's risk-management decision. If the bank takes excessive risk, the funding cost of this instrument rises.[1] What makes SD intriguing is that it can be used as a substitute for common equity shares to meet a bank's regulatory capital requirements.

Although the economic and policy literature on SD is vast, and international in scope, to date there has not been any research into the link between SD and market discipline in Canada.[2] This paper attempts to close that gap.

Identifying potential sources for market discipline is a timely endeavour, given that the Basel Committee on Banking Supervision, in its Basel II Accord (BCBS 2004), has declared market discipline to be one of its three pillars for capital adequacy. This reflects a belief that many international banks are too large and complex to be monitored effectively by regulators. The solution proposed in the Basel II Accord is to develop better disclosure methods and improve the ability of markets to monitor the activities of banks.

In addition, under Basel II, larger (and internationally active) banks are given the opportunity to rely on the Advanced-Internal Ratings Based approach (A-IRB) for determining risk-based capital requirements.[3] An A-IRB bank is required to provide its estimates of loss given default, probability of default, and exposure at default on each credit risk to determine risk-based capital requirements. The reliance of supervisors on banks to supply key inputs in determining capital requirements has potential for moral hazard. In particular, a bank facing financial difficulties could always adjust the assumptions (or parameters) used to measure risk-based capital. Although this would be ultimately identified through backtesting, it could buy time for the bank as it attempts to internally avert a crisis.[4] This reliance of supervisors on banks' own internal ratings presents a strong argument for ensuring that market discipline exists prior to the implementation of the Basel II Accord in 2008.

Bank managers do not want to incur higher financing costs. As a result, when market discipline looms over a manager's decisions, the incentive for risk-taking (the moral hazard problem) can be curtailed. A policy question this study addresses is whether the current regulatory and market environment, in Canada, is adequate for SD to act as that deterrent. This analysis is carried out by two means. First, a qualitative description of Canadian market conditions is given. Key characteristics identified can be compared with other international

[1] Section 2 provides additional details about subordinated debt and how it relates to market discipline.

[2] See Board of Governors (1999) for a survey of the issues that have been addressed in the United States with respect to SD. Sironi (2000a) provides a European survey.

[3] For instance, OSFI will require banks with equity of $5 billion or more (namely, the Big Five banks) to adopt the A-IRB approach (OSFI 2004).

[4] Daníelsson et al. (2001) argue that this methodology "may induce perverse behaviour in times of crisis if unchecked."

studies.

Second, a quantitative analysis is conducted to determine whether there is any evidence of market discipline. In particular, a Tobit model is used to identify which factors affect the issuance decisions of banks. A Tobit model is chosen since there are many unobservable factors of varying magnitude that affect the decision not to issue. Unfortunately, only the decision not to issue can be observed. This implies the need to use a truncated-distribution estimation model. Meanwhile, if the bank does issue, the amount issued is observable, which makes the Tobit model a better choice over other binomial response models.

Independent variables in the regression function include measures of the current and future economic performance of the bank. This includes measures of the bank's profit and the quality of its loan portfolio. In order to isolate the sensitivity of the issuance decision to these bank-specific risk factors, additional control variables are introduced to account for general macroeconomic, business cycle, liquidity, and risk conditions.

The sample consists of cross-sectional time-series data that track domestic banks and foreign bank subsidiaries in Canada over the past decade. Various panel data estimation techniques are employed to control for unobserved heterogeneity among banks. There are well-established techniques of controlling for fixed and/or random effects in a standard linear regression model. There is no closed-form method, however, for conditioning fixed effects out of the Tobit likelihood function (due to the non-zero probability associated with the event of non-issuance). Consequently, this paper employs techniques to control for fixed effects, as suggested by Greene (2004). In particular, a set of bank-specific dummies is included to control for unobserved bank heterogeneity. This technique has not been helpful in panel data models, where the time-series dimension is small. Greene's simulations, however, suggest that the concerns of consistent estimates are less of an issue when the time-series dimension is longer.

Although the analysis is restricted by a small cross-section, the preliminary results suggest that there is some evidence of domestic banks attempting to evade market discipline. If a publicly observable measure of the likelihood of default increases in value, this tends to cause a significant reduction in issuance of SD, which indirectly suggests that market discipline is present. Otherwise, the bank would not need to avoid issuing under adverse circumstances.

Likewise, this paper identifies 'timing' behaviour in the smaller domestic banks' issuance decisions. In particular, a measure of loans that are past due but have not been publicly declared to be impaired is found to have a significant and positive effect on the decision to issue SD. This effect is found to be stronger, on average, for a sample of domestic banks, relative to a domestic subsample consisting of the 'Big Five' banks (the five largest Canadian banks). Meanwhile, an increase in impaired loans is found to have a negative and significant effect on the issuance decision.

A common criticism of the subordinated debt–market discipline connection is that it will fail to operate effectively if holders believe that weak banks will be bailed out. Consequently, the price of this debt will not reflect a default risk premium, and bank risk-taking will be undeterred. If such is the case, however, then the banks' issuance should not follow any systematic pattern. Instead, this paper finds a pattern for domestic banks: namely, they issue before warning signs become publicly apparent and they then become reluctant to issue

when loans are subsequently declared impaired, *ceteris paribus*.

The implication is that, if banks are able to 'time' their issuance decisions and avoid any funding consequences, then a mandatory SD issuance policy may be necessary for market discipline to be adequately effective. In this way, a bank cannot avoid issuing whenever it experiences poor results in the previous quarter. A mandatory issuance policy might appear to be punitive under this rationale; however, it creates incentives for banks to avoid taking excessive risk in the first place.[5]

This paper also finds that a 'size' factor is positively related to SD issuance in a sample of all domestic banks and foreign bank subsidiaries. The analysis suggests that larger, well-established domestic banks issue SD with the greatest frequency. This is consistent with international evidence that suggests there are fixed costs of issuing that necessitate a minimum nominal size to the series. This threshold consequently can act as a barrier to smaller domestic and foreign bank subsidiaries. Yet, even though it is the larger domestic banks that issue, there is no identifiable pattern in their issuance decisions.

Consequently, the policy implications of these empirical results are mixed. There is evidence that market and balance sheet conditions affect the decision to issue. Balance sheet factors, however, appear to be more important for the smaller domestic banks while larger banks' issuance decisions show little sensitivity to default risk characteristics. Few of the standard measures of default risk are found to impact on SD issuance of the Big Five subsample. This is disappointing since, ideally, policy-makers want this group to be subject to market discipline. Also, it is the smaller banks, which would face a relatively larger burden complying with a mandatory SD policy, that exhibit greater sensitivity. These results are consistent with a market perception of larger Canadian banks being 'too big to fail.'

The remainder of this paper is organized as follows. Section 2 describes the advantages and drawbacks of SD. Section 3 reviews empirical evidence and policy proposals from other countries where banks issue SD. Section 4 provides qualitative and quantitative descriptions of SD markets in Canada over the past decade. Section 5 conducts an empirical analysis to identify which factors affect banks' issuance decisions. Section 6 describes the empirical methodology. Section 7 analyzes the results. Section 8 offers some conclusions. Appendix A identifies the variables used, and Appendix B identifies the banks included in this study.

2. What is Subordinated Debt?

SD is a fixed-income financial instrument that is both unsecured and junior (subordinate) to all other obligations of the bank.[6] Unsecured implies that there are no underlying assets of the bank that can be claimed by the holder in the event of bankruptcy. Junior implies that all other creditors receive priority on claims (including the deposit insurer) if the bank is

[5]Feldman and Stern (2004) refer to the pre-emptive role that market discipline plays as creating a "virtuous circle," whereby banks do not fail because they do not take excessive risk, and as a result they enjoy better funding consequences.

[6]SD can be issued by any commercial enterprise. However, this paper discusses the use of SD as a tool for market discipline purely in the context of banking.

liquidated.[7] These characteristics imply that the risks of holding a bank's SD are perceived to be greater than its more senior debt obligations. The ratings provided by the Dominion Bond Rating Service (DBRS) give an example of the perceived differences. For all seven banks that the DBRS tracks, SD is consistently one risk-rating lower than all other debt categories.

SD is particularly attractive to regulators because the contingent payoff stream mimics the expected exposure faced by the deposit insurer. Under general business climates, the SD holder does not benefit from increased bank risk-taking. Greater risk-taking does, however, increase the downside costs to the holder, provided it increases the probability of failure. These instruments' prices therefore tend to be very sensitive to risk. In contrast, the responses of equity holders tend to be muted, since they stand to benefit from successes that accrue from increased bank risk. There is evidence that, in extreme scenarios, equity prices in corporations close to insolvency are positively related to risk-taking behaviour (Hughes et al. 1998).[8]

2.1 Advantages of subordinated debt

SD has the potential to be an effective instrument for market discipline. Market discipline is defined as the ability of the markets to affect the risk-taking decisions of banks in an efficient manner. The literature identifies indirect and direct disciplinary effects that SD prices can have on bank behaviour (Board and Treasury 2000). Direct market discipline exists when higher default risk leads to increases in the risk premium demanded by potential SD creditors. Since this increases the bank's cost of raising capital, there is an incentive to pre-emptively limit excessive risk-taking. Indirect discipline occurs when a change in a bank's default risk reduces the secondary market price for SD. Since these price movements act as a signal of the market's perceptions of the solvency of the bank, supervisors and market participants can use this information to scrutinize the bank's activities. If a bank wants to avoid this burden, it can do so by lowering its risk-taking, ex ante.

Still, there are prerequisites for SD to be an effective tool for market discipline. For instance, SD must constitute a minimum proportion of total assets, so that it has an impact on the cost of raising capital. If the amount issued is too small, then there is little influence that the holders of SD can wield over the managerial decisions of the bank.

In addition, holders of SD must be sophisticated enough to be able to interpret the array of public and private information about the bank with sufficient accuracy. This implies a minimum level of infrastructure for a creditor to follow a bank. Consequently, this suggests that high information costs can make the buyers' side of the market thin.

[7] Only equity holders are junior to holders of SD.

[8] There is theoretical (but not empirical) evidence that the same property holds for SD, provided the bank is insolvent. If a bank is insolvent but has not been closed, any risk-taking that raises the chance of avoiding bankruptcy could be valuable to holders of unsecured debt. Note that they also bear additional downside risks, since if the gamble fails there will likely be even fewer assets left to liquidate. See Black and Cox (1976), and Gorton and Santomero (1990) for further discussion of the non-monotonic relationship between SD prices and volatility in stock prices.

As well, holders of SD must believe that the probability of repayment is contingent on the performance of the bank. If the holders of SD believe there is an implicit guarantee from the government behind the debt, they will not necessarily discipline the bank. Consequently, the only information that SD price movements will reflect are bets on the existence of an implicit guarantee, or other factors, such as liquidity premia.[9]

In addition to direct and indirect effects through prices, market discipline can be manifested through non-price means. For instance, holders of SD expect to be among the first set of creditors to bear loss in the event of bank insolvency. As a result, they have an incentive to pressure the regulators (including the deposit insurer) towards early bank intervention. Equity holders, by contrast, face mixed incentives for seeking supervisory intervention in the event of bank weakness. This is especially true in an environment of least costly resolution, where liquidation is a more likely outcome, other things being equal. If a bank is liquidated with positive capital, then the equity holders will bear more of the costs of resolution. Likewise, if the bank remains open and avoids early regulatory intervention while its capital continues to deteriorate, the net benefits of increased risk-taking by the bank accrue mainly to equity holders. Ultimately, they have nothing to lose.

SD can also be beneficial to the overall robustness of the safety net. Owing to its junior status, SD acts as an additional buffer for the deposit insurer, since losses to holders of SD must be 100 per cent before the insurance fund is at risk of loss.

2.2 Drawbacks of subordinated debt as a tool for market discipline

Of immediate concern is whether a commitment to not protect the holders of SD, in the event of a bank failure, is a credible policy for regulators. There is a time-consistency issue underlying this set-up. Consequently, an announced policy of no support might not be believed by the market, thus creating greater losses for uninsured creditors of the bank. Under these conditions, policy-makers might discount the future costs of bailout relative to the present costs of bank distress, leading to a reversal in positions. Market participants understand this tenuous credibility and consequently the instrument's price may not reflect default risk, making it a cheap form of capital for the bank. Further, if the SD issued is replacing common equity as regulatory capital, and is insensitive to default risk, then risk-taking is more likely to increase, contrary to the desired outcome. Essentially, the bank is more leveraged but no longer facing any economic capital constraints. Under these conditions, SD is no better than insured deposits.

Some authors argue further that, even if there is no implicit guarantee, a moral hazard problem still exists between the manager and potential holders of SD. The ex ante risk premium on SD might not be sufficient to limit risk-shifting ex post (Levonian 2000; Blum 2002). This argument suggests that SD does not eliminate moral hazard but, instead, redistributes the cost of excessive riskiness back onto the bank. Chan, Greenbaum, and Thakor (1992)

[9] A classic example of this occurred in the stock prices for 13 nationally chartered banks in the United States, after the bailout of Continental Illinois in 1984. These banks were declared to be too-big-to-fail by the Office of the Comptroller of Currency. The stock prices for the 13 banks subsequently rose in response to the announcement (O'Hara and Shaw 1990).

obtain similar results: moral hazard cannot be eliminated in a single-period game through risk-weighted deposit insurance premia. The authors show, however, that moral hazard can be mitigated in a multiperiod setting, as soon as reputation effects are accounted for.

There is no guarantee that SD price movements provide accurate signals of a bank's financial condition. This is especially true if secondary markets are thin. One example of a false positive might entail a holder selling its stake (perhaps purely to generate liquidity). The subsequent downward price movement could trigger a bank run by uninsured depositors.

3. Subordinated Debt Policy and Research Review

3.1 Empirical evidence

The majority of empirical research has been conducted within the context of the U.S. prudential supervisory system. One of the first questions asked by researchers is whether there is evidence of a default-risk premium in the SD spread over some benchmark Treasury security. Early results in the 1980s suggested that the market did not extract any price for risk-taking (Avery, Belton, and Goldberg 1988; Gorton and Santomero 1990). Flannery and Sorescu (1996), however, with a longer sample period, show evidence of a risk premium in the post FDICIA period (1991 and on).[10] They argue that the contrary evidence in the 1980s (which their results support) represented a rational response of investors to a too-big-to-fail policy along with well-acknowledged perceptions of forbearance.[11] As soon as that institutional *ethos* was eliminated, the risk premium returned.

Research into the characteristics of SD issuance has found that SD was mostly issued by larger banks and bank holding companies. In fact, almost 97 per cent of SD dollars raised in 1998 were issued by the 50 largest insured commercial banks or their parents (Board of Governors 1999). Likewise, only 61 out of 8,159 banks with assets below $500 million issued SD (Lang and Robertson 2000). Size is an important factor in the issuance decision, since the liquidity premium is inversely related to the size of the institutions and the amount issued. Only the largest 15–20 banks in the United States have reasonably active secondary markets for their SD (Board of Governors 1999). Issues by the rest tend to be held by institutional investors until maturity or redemption.

In addition, Morgan and Stiroh (1999) find that larger banks enjoy a smaller risk spread, relative to debt issued by non-financial corporations of similar size. This advantage dissipates for smaller-sized banks relative to non-financial corporations. Again, this could be explained by market perceptions of an implicit government guarantee for larger banks.

There is also evidence that a minimum size of issuance is necessary to warrant coming to market. The Board of Governors (1999) has determined that the size of a typical issuance is between $250 and $400 million, with a lower bound of $150 million. This observation reflects fixed costs of issuance, along with the need to generate sufficient liquidity in the secondary market. If a bank chose to issue a smaller amount, it would have tremendous

[10] Federal Deposit Insurance Corporation Improvement Act (1991).

[11] For instance, the Garn St. Germain Act of 1982 was seen as an attempt to legislate new accounting standards that transformed insolvent banks into solvent ones.

difficulty attracting the attention of institutional investors in the U.S. market. Consequently, a liquidity premium would be attached to the series.

There has been a general trend towards standardizing SD contracts. Typically, the relative term-to-maturity tends to be greater than 10 years (Board and Treasury 2000). This characteristic is likely a reflection of minimum term-to-maturity rules established in the 1988 Basel Capital Accord, in order for SD to qualify as regulatory capital.[12] Coupon payments tend to be semi-annual and many specialized covenants (e.g., early redemption, call provisions) in these debt contracts in the 1980s have been eliminated (Board and Treasury 2000).

Research has also been conducted on SD markets in Europe (Sironi 2000a). These results mimic the U.S. studies with respect to size; however, there are two important distinctions. First, there are a large number of banks in Europe that are either nationalized or have some degree of overt government guarantee beyond deposit insurance. For these "state" banks, Sironi finds that there is very little spread in SD above government securities. Second, the regional nature of most banks in the European economy implies that a secondary market for SD is generally non-existent for all but the largest banks.

Another question that has been considered is whether the market provides any additional information that has not already been identified by supervisors. If it does not, then that would suggest that supervision is sufficient for determining the financial stability of a bank. DeYoung et al. (2001) find that bank examination ratings contain information not evident in secondary market prices. Berger, Davies, and Flannery (2000) determine that markets have information that is not available to supervisors. The conclusion appears to be that markets and supervisors can complement each other.

More recently, Covitz, Hancock, and Kwast (2003) have readdressed the issue of identifying a risk premium by correcting for selection bias. The problem with previous studies is that only banks that issued have a price signal to follow. Little is known about banks that choose to avoid issuing. Correcting for this bias, with a two-stage Heckman procedure, enables Covitz, Hancock, and Kwast (2003) to find that spreads have been risk-sensitive since 1985 in the United States. An interesting by-product of this procedure is that their first-stage probit analysis documents which factors explain the decision by a bank to issue SD. This paper will utilize their methodology in the Canadian context. A related paper by Covitz and Harrison (2004) finds that there is a "positive selection" attribute surrounding the issuance of SD by bank managers. Typically, the issuance is timed with the announcement of positive news, such as ratings migration. This is an example of 'timing' behaviour.

3.2 Policy proposals

This section summarizes key features of SD policies that have been proposed by academics and regulators alike.[13] Various SD policy proposals have originated in some form within the United States for over the past 20 years. Initially, the intention was to discipline banks by

[12] For instance, SD applied towards tier 2B capital must be a minimum of five years' maturity. See section 4.1.

[13] For a complete review of SD proposals, see Board of Governors (1999) or Evanoff and Wall (2000).

introducing a claim holder who was willing to step in and shut down the bank if it experienced difficulty in paying its debt (Benston et al. 1986). Later proposals were designed to limit forbearance by the regulator by establishing intervention triggers based on the ability, or inability, of the bank to issue SD. A more recent, and aggressive, proposal (Calomiris 1999) calls for SD to be issued at a minimally sufficient frequency along with a maximum-allowable cap on the spread for the issuance. If the bank either fails to meet the issuance frequency or is unable to issue without offering a spread above the cap, it would be required to shrink the size of its asset portfolio each month until the problem is rectified.

More recently, the debate has shifted to whether banks should be required to issue SD at regular intervals. In 1999, the Gramm-Leach-Bliley Act authorized the Federal Reserve and the U.S. Treasury Department to examine the efficacy of a mandatory SD issuance requirement. The findings were not supportive of this mandatory regime. For instance, the largest banks were already voluntarily issuing and there were barriers to issuance for smaller banks. Consequently, there was not sufficient evidence to warrant the expenditure necessary to support a mandatory issuance regime (Board and Treasury 2000). The report did not reject the notion of a mandatory SD policy, but suggested that more research is needed before any change is made.

Another source of disagreement has been what limitations should be set on the minimum term-to-maturity of SD. Regulators tend to prefer longer maturities, establishing minimum thresholds (OSFI 2001). This reflects the use of SD as a form of regulatory capital, and the desire to ensure that it represents a form of 'permanence' in the financing of the bank. A problem regulators cite with shorter-term SD is that holders do not take into account the long-run effects of the bank's decisions, since the maturity of the security creates an exit option for the holder. From a practical standpoint, longer-term maturity may be necessary in order to provide banks with incentives to issue SD. The problem with issuing shorter term-to-maturity SD is that a bank must either float a larger proportion of SD outstanding at once or face higher issuance costs associated with smaller series. Either way, there is risk of a significant increase in the cost of raising funds. These factors become less important if the maturity is of sufficient length.

The argument for making SD maturity short is that it will be a more effective tool for market discipline. If maturity is very short, the SD operates in a manner similar to how demand deposits operated before deposit insurance was introduced (Calomiris and Kahn 1991). Since demand deposits have zero maturity, threat of withdrawal by the holder inhibits the risk-taking incentives of the bank's managers. Likewise, the potential inability to rollover SD acts as a similar deterrent towards risk-shifting by the bank. In addition, higher-frequency/shorter term-to-maturity SD refreshes information in secondary markets on a regular basis, which should improve liquidity. Proponents of maturity caps argue that it is the structure of the capital rules in Basel I that inhibits liquidity in SD markets (Shadow Financial Regulatory Committee 2000). To be eligible as a risk-based capital contribution, the SD term-to-maturity must be a minimum of five years under Basel II (and I) guidelines. This has created incentives for banks to issue less frequently with longer maturities in order to have access to a cheap substitute for equity capital.

Another issue debated is the ideal proportion of SD relative to assets. Recommendations

have ranged from 2 (Board of Governors 1999) up to 8 per cent (Lang and Robertson 2000). The Shadow Financial Regulatory Committee (2000) argues that the choice of capital structure (here the ratio of SD to equity) should be left to the bank, and that supervisors would be better to return to simple leverage ratios for determining capital adequacy. Since the proportion of SD to equity would be left to the bank, this proposal would represent a return to risk-based capital standards based on binding economic constraints, as opposed to regulatory constraints.

4. Subordinated Debt in Canada

4.1 Canadian regulatory environment

Most of the Office of the Superintendent's (OSFI) guidelines pertaining to SD can be attributed to compliance with the Basel I and Basel II Capital Accords.[14] SD can be counted as tier 2B capital, which implies that it can substitute for up to 50 per cent of tier 1 capital (basically, shareholder equity) in determining a bank's risk-based capital requirement.[15] OSFI considers SD not to be tier 1 capital because it is of limited life and does not represent a source of permanence in the bank's capital structure.[16] The only restrictions placed by OSFI for SD to qualify as tier 2B are that it: (*i*) be subordinate to deposit obligations and other senior creditors, and (*ii*) have an initial minimum term greater than, or equal to, five years. The issue of how limited-life instruments can contribute to capital adequacy is resolved with the use of 'straight-line amortization' in the last five years until maturity. This implies that in each of the last five years of maturity of the issue, the contribution towards capital of the principal is reduced by 20 per cent, to reflect the fact that fixed-income assets, which bear coupons, have a term-to-maturity greater than their actual duration.

SD contracts generally contain a covenant that no new SD will be issued that is senior to the pre-existing issue. In addition, SD is generally not redeemable. There are two exceptions, however: SD can be redeemed in the last five years, subject to OSFI's permission, or it can be redeemed prior to the last five years, provided it is being replaced by an equivalent amount of capital that is either junior or of equal priority to the outstanding principal. From the supervisor's perspective, replacing a shorter-duration capital instrument with a longer one represents an improvement in the quality of capital, which is why it will always be approved.

Recently (effective 1 January 1998), OSFI introduced new capital requirements to deal with market risk. Capital set aside for market risk is intended for banks that have a high degree of trading book assets or liabilities.[17] Tier 1 and 2 capital can be held against market risk along with newly introduced tier 3 capital that consists of SD with a maturity of greater than two years. Additional conditions placed on tier 3 SD are that it cannot be

[14] Details of this section are derived from the OSFI (1997) and OSFI (2001) guidelines on capital regulations.

[15] Any tier 2B capital above this threshold will not be counted as regulatory capital, but can be considered by the supervisor when evaluating the overall strength of the bank.

[16] Tier 2A capital includes perpetual debentures that have a 99-year term, but this does not constitute general SD, since it is a more permanent source of capital for the bank.

[17] Namely, 10 per cent of total assets (or liabilities) and exceeding $1 billion (OSFI 1997).

redeemed prior to maturity without OSFI's approval, and payment (even at maturity) can be postponed if there is concern that it would reduce the bank's capital below a minimum standard. Other limits include that tier 2 and tier 3 capital cannot exceed 200 per cent of tier 1 capital that is attributed to market risk requirements. In addition, tier 2 and tier 3 capital have an overall limit of 100 per cent of tier 1 capital. Banks cannot exceed this overall limit without OSFI's permission and, generally, that would be allowed only for institutions engaging primarily in trading activities.

Issuance of SD is currently voluntary in Canada. Since 1994, banks have been required to obtain the prior consent of OSFI when the location of issuance is outside of Canadian legal jurisdiction.

4.2 Canadian market facts

Use of SD by banks is quite sizable in Canada. Total SD outstanding among all banks in Canada as of 30 September 2004 was approximately $27 billion, roughly 1.5 per cent of the total assets of domestic and foreign subsidiary banks ($1.8 trillion). SD outstanding as a percentage of total assets has declined from roughly 2 per cent in 1996 to as low as 1.36 per cent in July 2003, for domestic banks.[18]

Figure 1 shows the ratio of aggregate SD to total assets for domestic banks (1996–present). These results differ from other countries. Sironi (2000a) summarizes the average ratio of SD to total assets across G-10 countries. Although Sironi tracks only the average ratio for banks with assets in excess of US$50 billion, the trend was upwards in the total EU area between 1996 and 1999 (1.26 per cent to 1.65 per cent). In the United States, over the same period, averages hovered around 2.5 per cent.

In addition, there has been a sharp trend downwards in the amount of SD outstanding issued in foreign currency by domestic banks (Figure 2). In 1996, the amount was roughly half of all SD issued, whereas today it accounts for only 18.6 per cent. This likely reflects a change in policy in 1994, when banks were required to seek permission from OSFI in order to issue in a jurisidiction outside of Canadian law.

Figure 3 shows the pattern of outstanding SD relative to total assets for the Big Five banks over the past decade. Although there has been some recent disparity in debt composition decisions by the Big Five banks, the figure exhibits a mild downward trend, which may reflect the emergence of other new hybrid securities that can also be used as substitutes for equity capital.[19] Alternatively, it might reflect an overall ratings downgrade by DBRS in 1999.[20] If one was to interpret this event in the context of the empirical results obtained by Covitz and Harrison (2004) for U.S. banks, a downgrade would reduce incentives for banks to issue longer-term debt (at least in the short term).

[18] Figures are derived from published monthly balance sheet statistics on OSFI's website.

[19] For example, preferred shares and income trusts have recently gained popularity.

[20] On 9 March 1999, the Big Five banks all received an overall downgrade by DBRS on each type of debt instrument outstanding. This reflected an impact analysis of the Government of Canada's decision to deny two mergers between four of the members. The analysis suggested that each of the banks were constrained to remain too small to become globally diversified (DBRS 1999).

Figure 1: Total Subordinated Debt Outstanding to Total Assets: All Banks Monthly, 1996–2004

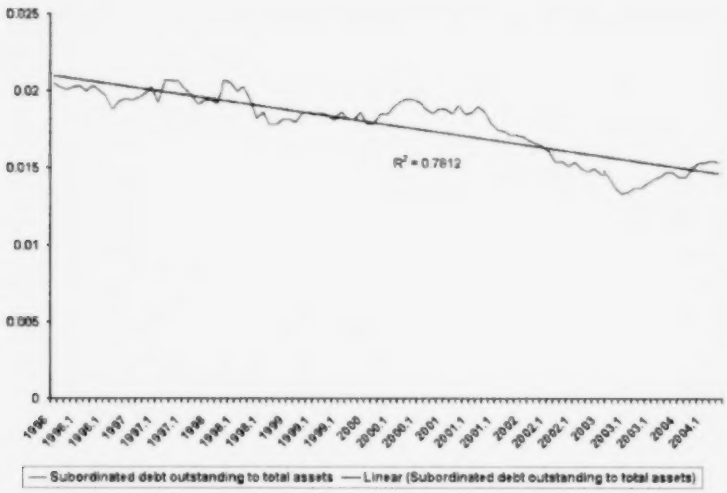


Figure 2: Ratio of Foreign Denominated to Domestic Denominated Subordinated Debt: All Banks Monthly, 1996–2004

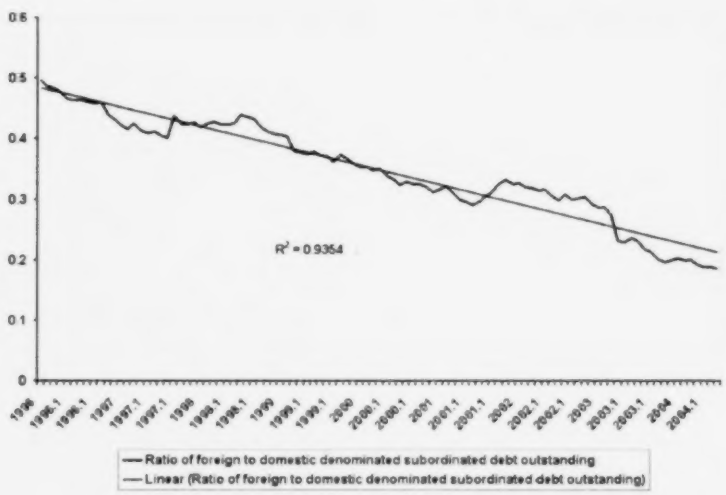
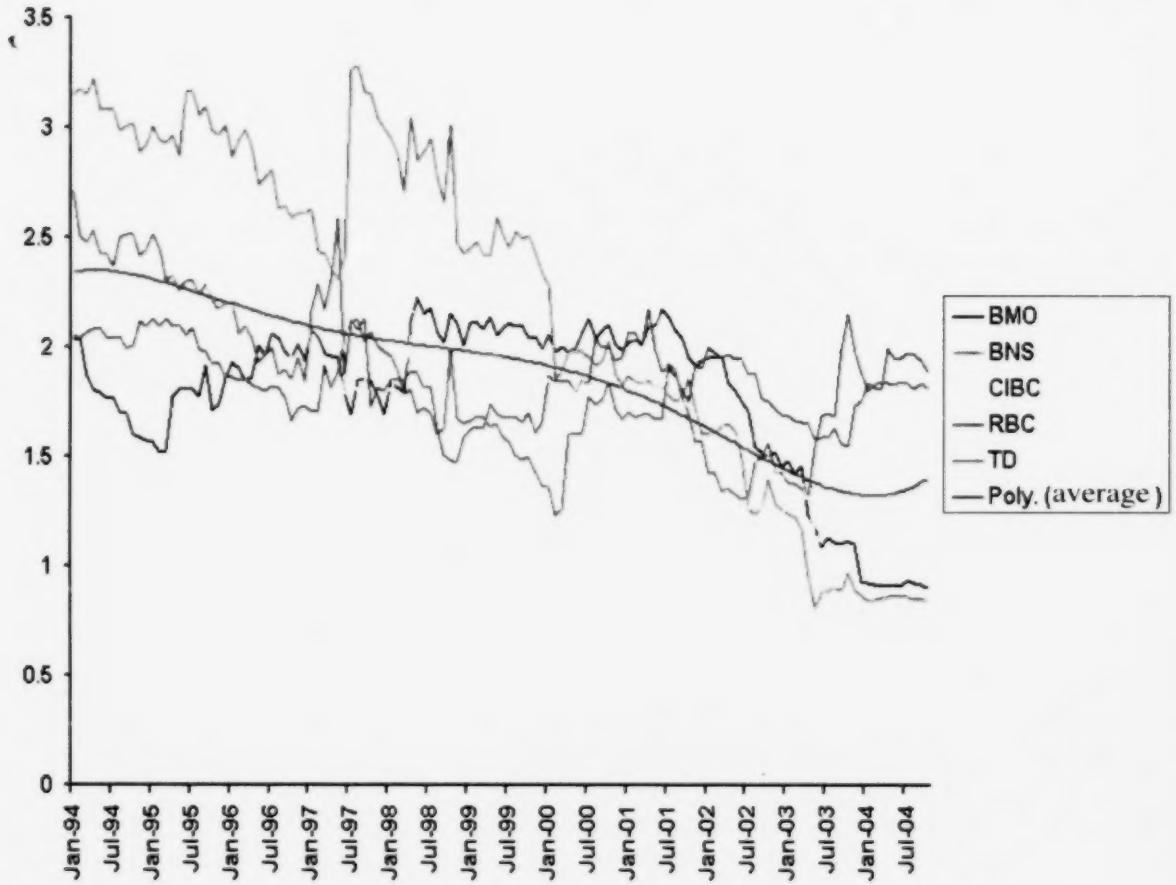


Figure 3: Subordinated Debt Outstanding to Total Assets: Big Five Banks Monthly, 1994–2004



Source: Statistics on OSFI's website. Poly. (average) is the polynomial trend line (order 5) fitted to the average SD outstanding to total assets among the Big Five banks. The average line is suppressed.

Also shown in Figure 3 is the cyclical trend in SD issuance around the credit cycle. In order to show this, the average SD outstanding to total assets is determined for all five banks. Next, a polynomial trend line (order 5) is fitted. In the last two years there has been a downturn in the trend ratio of outstanding SD. This reflects a lack of new issues combined with pre-existing issues maturing.

4.3 Market structure

In Canada, the decision to place SD publicly or privately appears to be directly related to size. All large domestic banks issue publicly, whereas smaller banks rely on private placement. When a bank wishes to publicly issue SD, the process is similar to issuing equity. First, the bank circulates a short-form shelf prospectus, in which it announces its intention to issue an amount of SD up to some pre-specified limit from time to time over a two-year window. The document also summarizes the general features of the debt security, explaining how it will be issued, along with general covenants and redemption options. The bank will either sell the debt to, or through, underwriters, or possibly agents. When the bank decides on the best time to issue, it circulates a supplementary prospectus that summarizes the transaction in more detail. This supplement provides information about the coupon rate, the dealers, the issue date, maturity date, and price.

These securities are often issued under a trust indenture, in which a trustee is expected to act in the best interest of all holders of SD in the event the bank defaults. For example, if directed by a minimum fixed percentage of holders (25 per cent, for example), the trustee requests immediate payment and initiates legal proceedings.

The holders of SD tend to be institutions, such as pension and mutual funds, that generally hold the debt securities until maturity. A by-product of this feature is the lack of secondary market liquidity, very similar to the evidence of Sironi (2000b). It is uncertain in which direction the causation runs, since, conceivably, fund managers might not hold these instruments to maturity if there was an active secondary market.

5. Structural Model of Subordinated Debt Issuance

The rest of this paper empirically analyzes Canadian bank issuance behaviour. Is the bank's issuance decision affected by its default risk, size, market liquidity, or general credit/macro conditions? Of particular interest is the first factor, because if higher default risk reduces the likelihood of issuance, *ceteris paribus*, then this is market discipline in action.

This section develops a structural model of the intertemporal decisions of banks to issue SD. The methodology chosen is similar to that used by Covitz, Hancock, and Kwast (2003). They conduct a probit analysis to determine factors that affected the issuance decision of a panel of large U.S. banks. Their decision to adopt a probit model as the estimation technique is motivated by the second stage of their analysis. The probit estimates are used to correct for sample selection bias in a regression of spreads of SD issues on various risk factors and controls. Due to the size of the Canadian market and data limitations on the pricing of SD in primary markets, a similar second stage will not be performed in this paper. Consequently,

more rigour is placed on behavioural implications that can be drawn from decisions to issue by Canadian bankers. Instead of using a binary relationship for the dependent variable, the data provide information about the size of the issuance, making Tobit the natural choice of estimation technique.[21]

Consider an economy with N banks over T periods. Bank i, in period t, will choose whether to issue SD based on factors that affect the issuance decision. Independent variables are divided into:

(i) bank-specific default risk factors (RF_{it}) and profitability indicators (PI_{it}) that predict the bank's future financial condition,

(ii) general business conditions (BC_t) that are non-specific to i, such as bond market liquidity and the position of the business/credit cycle, and

(iii) other organization-specific factors (OF_{it}), such as the size of the bank and recent issuance activity.

In addition, a bank might face pressure from the supervisor to increase capital if it falls through some regulatory threshold. Covitz, Hancock, and Kwast (2003) were able to use internally produced ratings from call reports of bank holding companies to the Federal Reserve. Likewise, in Canada, OSFI uses a risk-matrix measure to rate bank health. This measure is confidential and unavailable, and is therefore left unmodelled in the final empirical specification.

A bank's decision to issue is modelled to be dependent on its own idiosyncrasies, along with time-varying macroeconomic conditions that it has less influence over. The decision to issue a nominal amount, $ISSUE_{it}$, is conjectured to follow some unobservable utility functional relationship:

$$U_{it} = G(RF_{it}, PI_{it}, BC_t, OF_{it}).$$

If the current state is such that $U_{it} > 0$, then bank i chooses to issue based on a monotonic relationship between $ISSUE_{it}$ and U_{it}. If, instead, $U_{it} \leq 0$, only $ISSUE_{it} = 0$ is observed, regardless of how negative the latent realization of U_{it} is. Given these limitations, the issuance size variable is truncated on the interval $ISSUE_{it} \in \{0, (0, \infty)\}$. It is a continuous random variable over the positive real line, but has a non-zero probability associated with the point 0. Therefore, the proper estimation technique is Tobit.

For the issuance function $ISSUE^*_{it} = f(RF_{it}, PI_{it}, BC_t, OF_{it})$, it is predicted that as the likelihood of default increases, a bank that faces market discipline will be less likely to issue SD in a non-mandatory regime. Three other partial effects are standard: a bank is less likely to issue if it has been less profitable, business/credit/liquidity conditions overall are weak, or the bank is an infrequent issuer or is small. A test of whether the measures of default risk have any significant and negative impact on issuance will help answer the question of whether market discipline exists.

[21] Empirical results are found to be unaffected by the use of either probit or logit specifications instead of Tobit.

5.1 Variables

The variables used in the empirical model are summarized in Appendix A. To normalize issuance sizes across banks of varying size, the dependent variable ($ISSA_{it} = ISSUE_{it}/ASSETS_{it}$) will measure the amount of SD issued relative to total assets.

Default risk will be measured by five factors, all of which the bank knows entering period t. The first measure is the ratio of gross impaired non-mortgage loans relative to total assets ($GIMPNMA_{it}$). This measure essentially reflects the amount of bad non-mortgage loans a bank has publicly acknowledged. Alternatively, one could use net impaired loans as a measure, netting out loan-loss reserves; however, it is difficult to interpret the information content in loan-loss reserves.[22] A decision to increase loan-loss reserves can represent either acknowledgement of a higher level of existing impaired loans or information about expectations of future bank loan losses.

The second measure of default risk is ($WRITMA_{it}$), the amount of mortgage loan writeoffs relative to assets. Unfortunately, a series for gross impaired mortgage loans does not exist back to 1994. This likely reflects the differences in recovery value that are associated with these types of loans. A proportion of bank-originated mortgages are backed by mortgage insurance, which implies a more rapid recovery of funds whenever they are declared non-performing. Likewise, uninsured mortgages are backed by the collateral of the underlying property.[23] Consequently, writeoffs on mortgage loans are an adequate measure of bank default risk, since this represents a chargeoff against bank capital.

The third measure of default risk is the ratio of accruing non-mortgage loans past due 90 days to total assets ($NMLA90A_{it}$). The difference between accruing loans past due and impaired loans is that the former are still considered by the bank to be sound enough to continue to accrue interest. Once the ability of the borrower to repay the principal and interest becomes doubtful, the bank is supposed to redefine the obligation as impaired. However, there has historically been some discretion in this classification process. This represents a forward-looking measure of risk.[24] As this level of past-due loans increases, relative to assets, this should forecast future bank weakness.

The fourth measure of default risk is the carrying amount of real estate owned and other assets relative to total assets ($OREOA_{it}$).[25] Banks that have a higher degree of risky investments or that own foreclosed property tend to have a larger proportion of real estate on their balance sheets relative to safer banks.

The fifth measure of default risk is leverage (LEV_{it}), which represents the ratio of total assets to net worth. A bank with a high degree of leverage should be less likely to issue SD,

[22] Both net impaired loans and allowances for impairment are highly correlated with gross impaired loans. Results are similar.

[23] The Basel II Capital Accord recognizes this difference and generally assigns a lower risk-based capital weight to residential property than to corporate loans (BCBS 2004).

[24] Another forward-looking measure of bank default risk are estimated Z-scores on the eight largest domestic banks from 1994 to 2002. These data were assembled for Liu, Papakirykos, and Yuan (2004) and are used with their permission. This measure was not found to have a significant effect on SD issuance decisions.

[25] The carrying amount is the recorded investment in a loan or group of loans less any related allowances for impairment.

since the costs of issuance should be higher. Alternatively, if a bank faces a binding regulatory constraint that requires it to raise more capital, yet an economic constraint on capital is non-binding, it may choose to issue SD instead of issuing common shares. Consequently, a positive relationship between leverage and SD issuance is possible. This would support a 'cheap capital' hypothesis. The leveraged bank can raise capital without affecting the actual ownership structure of the bank.

This measure of leverage is based on the book value, which might create some inaccuracy in measuring economic leverage. Since the book value of equity tracks only the historic value of equity (for instance, loans are recorded at their historic value, not necessarily their current market value), it fails to fully represent the true economic value of the bank. Market capitalization, however, does reflect the market's perception of the future stream of cash flow from each share. The market value of equity can be approximated by summing the market capitalization of common equity with the book value of preferred shares. This creates a better measure of leverage, defined as $(MKLEV_{it})$. The drawback is that a bank must have equity that is traded in a secondary market, which further limits the availability of cross-sectional data.[26]

The prediction consistent with market discipline is that these measures of default should have a negative effect on the issuance decision of bank i at time t. However, a forward-looking measure of future losses (possibly based on private information) could be positively related to SD issuance. If the information is private, this could represent an inside manager's response to avoid market discipline. If market discipline is absent, then there should be invariance of issuance to the risk factors cited.

The profitability of the bank (PI_{it}) is measured using return on assets (ROA_{it}), which equals net income relative to total assets. Net income is measured as the sum of net interest income and non-interest income. Higher returns lead to a well-capitalized bank, *ceteris paribus*, and thus should be positively related to SD issuance.

General business conditions (BC_t) are measured using four controls: the unemployment rate (UR_t), the return on the TSE300 composite index in the previous quarter (TSE_t), a volatility index of prices on options traded on the Chicago Board of Options Exchange (VIX_t), and bond market illiquidity $(ILLIQ_t)$ as measured by bid-ask spreads on 90-day Government of Canada treasury bills.

The first two controls account for the state of the business cycle, while the third is an indicator of global risk. The fourth control is a proxy for SD market liquidity. If the spread on government treasury bills widens, then it reflects a lack of liquidity in the treasury bill secondary market, implying less liquidity in other commercial paper and debt markets. When there is a general lack of liquidity in bond markets, prospective holders of SD will demand a larger liquidity risk premium. Since this raises the cost of capital, bond market illiquidity should have a negative effect on SD issuance.

Measures of other bank-specific factors (OF_{it}) are either time-constant or time-varying. Time-constant variables specific to banks include bank dummies (B_i) intended to isolate individual heterogeneity. Time-varying variables include the size of the bank measured by

[26]Only eight Canadian domestic banks are publicly listed on the TSX, for which market capitalization could be measured.

the natural logarithm of bank assets (LNA_{it}). If size is a preliminary indicator of willingness to issue, this variable will have a positive effect on the issuance decision. The reputation or familiarity of the issuer to debt holders is also thought to be an important factor in the decision to issue. This is measured by ($ISSA_{i,t-1}$), the amount of SD relative to total assets issued during the previous period.

5.2 Data[27]

The assembled data consist of two cross-section time-series (XT) samples, starting in 1994 and 1998, respectively. The rationale for considering two separate XT samples is the entry of more banks between 1994 and 1998, along with the adoption of a new and more comprehensive reporting methodology by OSFI in 1996–98. The longer XT 1994 sample consists of quarterly observations from 1994Q2 to 2004Q2 on 14 banks. Eight of these banks are domestic and six are larger foreign bank subsidiaries (Fsubs). In the shorter 1998 XT sample, there are 28 banks, consisting of 10 domestic banks and 18 Fsubs. The data on bank-specific measures come from various reporting forms for deposit-taking financial institutions tracked by OSFI. Two additional risk factors ($NMLA90A_{it}$, $OREOA_{it}$) are available only after 1996 and 1997, respectively.

The 1994 panel begins in the second quarter. This reflects an oddity in Canadian accounting regulations. Banks have the option of reporting on an October or December end-of-year calendar. All banks in the 1994 sample are 'October' banks; hence, the end of the first quarter of the 1994 calendar year is January. Consequently, first-quarter issuance decisions of banks in 1994 are missing. All new banks added to the 1998 panel are 'December' banks.

Unfortunately, both panels end in the second quarter of 2004. This reflects a decision by OSFI in 2004 to discontinue the capital continuity reporting form. For public banks (those that issue shares traded on a Canadian stock exchange), decisions to issue in the third and fourth quarter of 2004 are provided on SEDAR.[28] There is an additional benefit to tracking these eight public banks, since one can measure economic leverage, as discussed in the previous section. Consequently, a third XT sample is constructed for publicly listed banks up to 2004Q4. It incorporates both the more recent SD issuances, along with the $MKLEV_{it}$ measure. In addition, this XT sample is broken into two panels. The first starts in 1994Q2, much like the previous 1994 panel. The other begins in 1997Q1, since the data exist for both $NMLA90A_{it}$ and $OREOA_{it}$ for each of the eight domestic public banks.

Although information exists about the issuance decisions of foreign bank subsidiaries, it should be treated with some caution. Often, issuance of SD by an Fsub comes with a letter of comfort or embedded guarantee from the parent. Hence, weakness in the Fsub may not affect its ability to repay.

Tables 1 and 2 provide summary statistics, segmented according to the total SD issuance,

[27] The data summarized come from various reporting forms that enable OSFI to track bank activities. Appendix A lists the variables used, and Appendix B lists the banks included in this study.

[28] System for Electronic Document Analysis and Retrieval (SEDAR) was developed in Canada for the Canadian Securities Administrators in 1997 to document all notifications and filings by public corporations. SEDAR is available at http://www.sedar.com.

the difference between the frequency of SD issuance from domestic banks versus that for foreign bank subsidiaries, and the SD issuance for the Big Five banks. The Big Five banks are examined on their own because they are active participants that are exclusively beyond $5 billion in equity, and thus they are expected to adopt the A-IRB approach. In addition, they would rank among the top 25 banks in the United States over the sample period in question. The behaviour of the large banks is of particular interest, since they represent the better candidates to effectively use SD.

Additionally, the Big Five banks have been more frequent issuers over the previous decade. Smaller domestic banks have all issued from time to time, as have a handful of more active foreign bank subsidiaries. There has been a recent drought in issuance both for large and small banks compared with the pre-1999 era.[29] There is also a difference in the size of issuance. The Big Five banks generally issue a series of minimum size: $200 million up to $1.5 billion. In contrast, aside from a few outliers of exceeding $200 million, most of the issues among small and foreign bank subsidiaries are below $100 million. Given that the surveys for the U.S. market document a minimum issuance size of US$200 million, this suggests again that it is worth examining the behaviour of the Big Five banks exclusively, where size is not a problem.

In Table 1, one issue of interest is whether there is any preliminary evidence of differences between the frequency of SD issuance for domestic banks and that for foreign bank subsidiaries. It appears that the answer is yes.[30] It is difficult to infer causality, since domestic banks in the 1994 sample were significantly larger than their foreign bank subsidiary competitors. A test of size based on assets shows that domestic banks were significantly larger than Fsubs in the 1994 sample.[31]

By similar methods, domestic banks are shown to be significantly more leveraged and have higher returns on assets compared with Fsubs. At the same time, the difference between the two groups' ratios of gross impaired loans to total assets is insignificant. Aside from the difference in size, there does not appear to be any reason to expect the issuance frequency to be much lower for foreign bank subsidiaries. Likewise if an Fsub chose to issue: then, in all but a few special cases, these offers were often backed by a guarantee from the foreign parent bank. Hence, the decision to issue may not necessarily reflect the status of the Fsub and, likewise, market discipline might not be as severe relative to domestic banks, *ceteris*

[29] This trend has reversed in the past year.

[30] A back-of-the-envelope calculation shows that a one-sided test of mean frequency issuance for domestic banks is greater than foreign bank subsidiaries (t-statistic (6.05)). One-sided tests of mean between two samples of sizes n_1 and n_2 are constructed using mean estimates, $\overline{X}_1$ and $\overline{X}_2$, and estimates of standard deviation, S_1 and S_2. The t-statistic is:

$$t_{(n_1+n_2-2)} = \left(\overline{X}_1 - \overline{X}_2\right) / \sqrt{\frac{n_1 S_1^2 + n_2 S_2^2}{n_1 + n_2 - 2}\left(\frac{1}{n_2} + \frac{1}{n_2}\right)}.$$

[31] The t-statistic was 18.596 on difference-of-mean tests on asset size, where the mean (standard deviation) total assets of domestic banks were $158 billion (115), while the six foreign bank subsidiaries had an average size of $6.05 billion (11.1).

Table 1: Summary Statistics, 1994–2004. Sample Means with Standard Deviations in Parentheses. $ISSUE$, $GIMP$, $WRITM$, NW, **and** NI **are denominated in thousands of dollars.**

	Full $N = 14$	Domestic $N = 8$	Fsubs $N = 6$	Big 5 $N = 5$
FRACTION	0.2058	0.2938	0.065	0.380
	(0.4047)	(0.4562)	(0.2471)	(0.4866)
ISSUE	56194	89227	3340	132911
	(179630)	(222523)	(14670)	(268604)
GIMP	786496	1249958	44958	1798122
	(992448)	(1018532)	(88193)	(861871)
WRITM	3724	5994	91.17	7462
	(8126)	(9688)	(457.3)	(10936)
NW	4671715	7417064	279157	1.11E07
	(5477040)	(5386856)	(456107)	(3123927)
NI	1019967	1612144	72483	2409712
	(1350132)	(1426746)	(157616)	(1223147)
LNA	16.569	18.165	14.016	19.23
	(2.634)	(1.642)	(1.768)	(0.310)
GIMPNMA	0.0085	0.0088	0.0080	0.0084
	(0.010)	(0.006)	(0.014)	(0.005)
LEV	17.981	20.665	13.687	21.286
	(6.408)	(2.816)	(8.017)	(1.757)
ROA	0.011	0.011	0.012	0.011
	(0.0188)	(0.005)	(0.029)	(0.005)

paribus. If anything, one would expect an Fsub to be more likely to issue, *ceteris paribus*. The drawback that likely limits issuance by Fsubs is familiarity and liquidity concerns of buyers. It is premature, however, to suggest that the size and familiarity of the issuer will drive the incentive to issue.

Table 2 highlights the same summary statistics for the 1998 sample. Comparisons between this sample and the first are generally ad hoc, since two additional small domestic banks and 14 small Fsubs have been added. However, comparison can be made with the Big Five banks, since these observations represent a subsample of the larger 1994 XT sample. There is a noticeable change in the mean issuance frequency between 1994–98 and 1998 on (as noted earlier). Another difference is between domestic non-mortgage gross impaired loans to assets relative to Fsubs. The latter is 4 times as large. Consistent with the previous sample, issuance frequency by Fsubs is much lower. In addition, there are some outliers in this sample when measuring net income. As a result, the estimated return on assets for Fsubs is quite sizable. This discrepancy is the result of significant changes in balance sheet

Table 2: Summary Statistics, 1998–2004. Sample Means with Standard Deviations in Parentheses. $OREOA$ and $NMLA90A$ are measured in percentages. $ISSUE$, $GIMP$, $WRITM$, NW, and NI are denominated in thousands of dollars.

	Full $N = 28$	Domestic $N = 10$	Fsubs $N = 18$	Big 5 $N = 5$
FRACTION	0.103	0.219	0.038	0.308
	(0.304)	(0.414)	(0.193)	(0.463)
ISSUE	25006	66495	1956	122125
	(126783)	(205361)	(11956)	(275921)
GIMP	361052	953133	32118	1726108
	(738021)	(987916)	(55114)	(807268)
WRITM	1487	4039	69.82	5889
	(5209)	(8078)	(641.1)	(9589)
NW	2591392	6848647	226250	1.28E+07
	(4902890)	(6240665)	(354347)	(2413397)
NI	504999	1352346	34252	2526593
	(1100388)	(1503242)	(99560)	(1293751)
LNA	15.061	17.438	13.741	19.413
	(2.671)	(2.324)	(1.794)	(0.162)
GIMPNMA	0.017	0.0053	0.0240	0.0063
	(0.0422)	(0.0038)	(0.0514)	(0.0028)
OREOA(%)	0.018	0.014	0.020	0.012
	(0.0486)	(0.027)	(0.010)	(0.011)
NMLA90A(%)	0.273	0.315	0.249	0.165
	(0.453)	(0.297)	(0.519)	(0.062)
LEV	14.950	20.192	12.038	21.548
	(6.636)	(3.336)	(6.211)	(1.596)
ROA	0.025	0.010	0.033	0.009
	(0.217)	(0.005)	(0.271)	(0.004)

composition and the timing of net income records.[32]

6. Empirical Methodology

A censored XT Tobit model is of the general form:

$$y_{it}^{*} = \mathbf{X}_{it}\beta + \phi D + \omega\theta_i B_i + (1-\omega)v_i + \epsilon_{it}, \quad \epsilon_{it} \sim iidN(0, \sigma_\epsilon^2), \tag{1}$$

$$y_{it} = max(0, y_{it}^{*}), \tag{2}$$

where y^{*} is observed only when it is greater than zero. Hence, y^{*} is the latent variable while $y \geq 0$ is actually observed, leading to a truncated distribution. β is a $K \times 1$ of estimator coefficients, corresponding to the $1 \times K$ vector explanatory variable of observations for bank i at time t ($\mathbf{X}_{it}$). D is a vector of quarterly dummy variables intended to control for seasonality.

Given the XT nature of the data, unobservable heterogeneity in the cross-section must be taken into account either by fixed-effects estimation or random effects.

(i) *Fixed-effects estimation*

If, instead, ω is set equal to one, then the model accounts for fixed effects where B_i is an indicator (dummy) variable for bank i. Generally in linear regression models, first-differencing is the standard method for sweeping out fixed effects in panels. The Tobit estimation model is non-linear, however, which implies that fixed effects cannot be swept away by differencing. Two alternative approaches are to estimate an unconditional fixed-effects Tobit model using indicator variables for the bank type or, alternatively, to use semi-parametric estimation.[33] Although this paper adopts the first approach, it should be noted that estimates can be biased (STATA 2003). As discussed in section 7.4, however, this bias reduces considerably for a sufficiently large T.

(ii) *Random-effects estimation*

If the model to be estimated is random effects, then ω is set equal to zero and the resulting variable, v_i, is treated as an independently and identically distributed normal random variable, with mean zero and variance σ_v^2. This leads to an estimated panel-level variance component ($\hat{\sigma}_v^2$) and an overall variance component ($\hat{\sigma}_\epsilon^2$). In addition, the per cent contribution to total variance of $\hat{\sigma}_v^2$ can be measured as:

$$\hat{\rho} = \frac{\hat{\sigma}_v^2}{\hat{\sigma}_v^2 + \hat{\sigma}_\epsilon^2}. \tag{3}$$

If the hypothesis, $\hat{\rho} = 0$, cannot be rejected, then the contribution of the panel-level variance is unimportant and the panel estimator is no different than the pooled Tobit estimator without v_i. As a result, pooled estimates are also provided.

[32] One Fsub recorded a 255 per cent ROA in one quarter due to a massive reduction in asset size while recording positive net income. In the previous quarter its ROA was negative.

[33] Honoré (1992) developed a semi-parametric estimator for conditional fixed-effects models with truncation based on least average deviations of the median estimator.

7. Results

A variety of specifications are estimated, mainly to provide robustness checks. In addition, given the institutional differences between SD issued by foreign bank subsidiaries versus domestic banks, each XT sample is examined as a full sample, a purely domestic sample, or simply the Big Five banks. Specification tests suggest that fixed effects are present while random effects are not. The results from fixed-effects estimation are therefore described first, followed by a summary of the test results.

7.1 Fixed-effects Tobit estimation

To control for unobservable firm-specific characteristics, bank dummies are added to a pooled Tobit estimation model. The results are summarized in Table 3.

(i) *Issuance is affected by some default risk factors, mainly for domestic banks but not foreign bank subsidiaries.*

The issue of interest is the sign and significance of default-risk measures. ($GIMPNMA$) is negative and highly significant for each of the 1994 subsamples. In the 1998 sample, however, it is significant only for the domestic bank subsample.[34] This suggests that other factors determine the decision by a foreign bank subsidiary to issue. Interestingly, there is a lack of evidence in the 1998 subsample of Big Five banks' decisions to issue being sensitive to any factor.

Mortgage writeoffs ($WRITMA$) appear to have a negative effect on the issuance decisions of the 1994 bank sample. Notably, the domestic bank subsample shows the strongest relationship. This variable is not significant for the Big Five banks, suggesting less sensitivity of the decision to issue than to the performance of their mortgage loan portfolios. All 1998 subsamples show little sensitivity to mortgage writeoffs.

Both of the new 1998 indicators of balance sheet risk ($OREOA$ and $NMLA90A$) provide additional factors to assess the market discipline argument. $NMLA90A$ is positive and highly significant in the domestic subsample (the coefficients are also positive for the other two subsamples, but less significant). This seems peculiar. An increase in non-mortgage loans 90 days past due but still accruing interest leads to an increase in SD issuance. This can, however, be consistent with market discipline. A bank that is expecting to take on an increase in impaired loans in the future would wish to raise capital in order to avoid higher capital costs later, upon the loans being treated as impaired. Meanwhile, ($OREOA$) is negative but not significant in any of the subsamples.[35]

(ii) *The effect of leverage on issuance decisions is weak and tends to support a "cheap capital" hypothesis.*

[34] In the Big Five subsample, the parameter estimate is negative, with a p-value of 0.18.

[35] A single-tailed test of $OREOA \geq 0$ would be rejected at 10 per cent.

Table 3: Tobit Fixed-Effects Estimates of Factors that Affect the Issuance Decision

	Full (94) $N = 14$	Domestic (94) $N = 8$	Big 5(94) $N = 5$	Full (98) $N = 28$	Domestic (98) $N = 10$	Big 5(98) $N = 5$
GIMPNMA	−0.9220***	−0.2258**	−0.1438**	−0.0336	−1.0736***	−0.2526
	(0.2539)	(0.0985)	(0.0647)	(0.1460)	(0.3660)	(0.1850)
WRITMA	−14.5563**	−6.4768***	−2.5812	−0.6995	−0.6812	5.7277
	(6.8830)	(2.3219)	(4.8542)	(4.4533)	(2.7613)	(11.3470)
LEV	0.0002	0.0004	0.0002	0.0004*	0.0009***	0.0002
	(0.0004)	(0.0003)	(0.0002)	(0.0002)	(0.0003)	(0.0002)
NMLA90A				0.1702	10.5448***	2.8694
				(0.4546)	(2.5301)	(1.8278)
OREOA				−2.7731	−5.8418	−4.2782
				(3.1338)	(3.7320)	(3.1138)
ROA	0.0302	0.6792	0.2102	−0.0156	0.6647	0.4915
	(0.1072)	(0.5013)	(0.3098)	(0.0194)	(0.5908)	(0.3549)
LNA	0.0022	−0.0005	0.0006	0.0047***	0.0025	−0.0008
	(0.0036)	(0.0022)	(0.0015)	(0.0018)	(0.0030)	(0.0027)
$ISSUE_{t-1}$	−0.5706	−0.2245	−0.0609	−0.0757	−0.2173	−0.1003
	(0.5397)	(0.2198)	(0.1775)	(0.2785)	(0.2431)	(0.2565)
ILLIQ	−0.0050	0.0004	0.0002	−0.0014	0.0014	0.0017*
	(0.0032)	(0.0012)	(0.0006)	(0.0026)	(0.0021)	(0.0010)
VIX	−0.0005**	−0.0002*	−0.0001*	−0.0003*	−0.00024*	−0.00010
	(0.0003)	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0001)
TSE	0.0005	−0.00001	0.0006	−0.0003	−0.0006	−0.0004
	(0.0013)	(0.00001)	(0.0008)	(0.0017)	(0.0015)	(0.0008)
UR	0.0006**	0.0006	0.0006	0.0008	−0.0004	−0.0001
	(0.0006)	(0.0004)	(0.0004)	(0.0014)	(0.0012)	(0.0006)
$ln\mathcal{L}$	212.251	286.220	298.355	166.805	170.994	162.951
NT	506	312	195	700	250	125
$\hat{\sigma}$	0.0128	0.0044	0.0021	0.0073	0.0046	0.0018
$\Phi(X\hat{\beta}/\hat{\sigma})$	0.1679	0.2667	0.3599	0.098	0.202	0.291

Notes: Standard errors are in parentheses. * represents significance at the 10 per cent level, ** at the 5 per cent level, and *** at the 1 per cent level. $\Phi(z)$ represents the cumulative standardized normal distribution, evaluated at z. Controls are $ILLIQ$, VIX, TSE, and UR. Quarterly and Bank dummy estimates are suppressed.

With respect to leverage (LEV), there is no evidence of a negative relationship. In fact, there is weak-to-significant evidence of a positive relationship between increased leverage and SD issuance. Given that this is significant in the full 1998 and domestic 1998 sample, this suggests that some banks view SD as a form of cheap capital. A bank experiences an increase in leverage, and needs to top up their capital, perhaps due to some regulatory constraint. The choice is to issue SD.

(iii) *There is a size effect. Smaller banks and foreign bank subsidiaries are less likely to issue.*

In the 1998 full sample, size appears to have a positive effect on issuance decisions. The coefficient on LNA is positive and significant. Results are inconclusive in the other subsamples. A positive result in the full 1998 subsample suggests that the market is less accessible to smaller domestic banks and foreign bank subsidiaries.[36] There is a lack of relationship between size and issuance decisions for the Big Five banks. This is expected, given their similarities in terms of size.

(iv) *There is little evidence of a liquidity effect on issuance decisions.*

With respect to the controls, of interest is the weak relationship between $ILLIQ$ and the decision to issue SD. This lack of evidence suggests that bond market illiquidity does not deter banks from issuing. In fact, just the opposite occurs.[37]

7.2 Interpretation of partial effects

In Tobit estimation models, slope coefficients cannot be interpreted as the true marginal effect of an independent variable on the expected value of the dependent variable, much like one would with a linear regression. The underlying distribution generating $ISSUE_{it}$ is truncated at zero. Consequently, to determine the partial effect of an independent variable on the expected value of $ISSUA_{it}$ involves multiplying the estimated slope coefficient by an estimate of the probability that $ISSUA_{it} > 0$ conditional on the realization of X_t (the vector of independent variables).[38] Following this procedure leads to an estimate of the magnitude, or partial effect:

$$\frac{\partial E[ISSUA|X]}{\partial X_j} = \hat{\beta}_j \times \Phi(X\hat{\beta}/\hat{\sigma}), \quad j = 1..n. \tag{4}$$

Both of these measures are provided in Table 4.

[36] Table 8 summarizes the pooled Tobit results (without bank-specific dummies) and further confirms a strong positive relationship between bank size and the issuance decision. LNA is positive and significant in both the 1994 and 1998 full samples, along with the domestic 1998 subsample.

[37] Additional factors were considered but ultimately dropped in the final estimation model. For instance, a time series was constructed of the cumulative maturity gaps (the difference between assets and liabilities maturing within one year) of all banks within the sample as a measure of liquidity within the banking sector. Results were weak, and interpretation of this as a measure of bond market liquidity is tenuous. Also, spreads between long-term AAA and AA commercial paper over government bonds were considered. Results were insignificant.

[38] See Wooldridge (2001), chapter 17, for a description of this procedure.

Table 4: Partial Effects on $ISSUE$ from Selected Shocks to the Bank's Financial Condition (thousands of dollars)

Subsample	Variable	$\hat{\beta}$	$\Phi(X\hat{\beta}/\hat{\sigma})$	$\hat{\sigma}_{X_j}$	lnA	$\Delta E[ISSUE\|X]$
1994 Full	GIMPNMA	-0.9220	0.1679	0.01	16.659	-24,154
1994 Domestic	GIMPNMA	-0.2258	0.2667	0.006	18.165	-27,981
1994 Domestic	WRITMA	-6.4768	0.2667	0.000239	18.165	- 32,009
1994 Big 5	GIMPNMA	-0.1438	0.3599	0.005	19.23	-57,956
1994 Big 5	$WRITMA^{\dagger}$	-2.5812	0.3599	0.000057	19.23	-11,915
1998 Domestic	GIMPNMA	-1.0736	0.202	0.0038	17.438	-30,846
1998 Domestic	NMLA90A	10.5448	0.202	0.00297	17.438	236,795
1998 Domestic	LEV	0.0009	0.202	3.336	17.438	22,701
1998 Big 5	$GIMPNMA^{\dagger}$	-0.2526	0.291	0.0028	19.413	-55,519
1998 Big 5	$NMLA90A^{\dagger}$	2.8694	0.291	0.00062	19.413	139,647
1998 Big 5	$LEV^{\dagger}$	0.0002	0.291	1.596	19.413	25,056

† implies that the estimated coefficient was **not** found to be significant at least at the 10 per cent level.

Ultimately, the motivation is to measure the nominal impact that a change in a measure of bank fragility has on the issuance decision, *ceteris paribus*. First, a standardized shock must be decided upon. For simplicity, the shock is defined as a one-standard-deviation adverse movement from the estimated mean of the independent variable in question:

$$\Delta E[ISSUA|X] = \hat{\beta}_j \times \Phi(X\hat{\beta}/\hat{\sigma}) \times \hat{\sigma}_{X_j}, \quad j = 1..n. \tag{5}$$

Next, in order to get the measure in dollar amounts, the right-hand side is multiplied by the estimated mean of total assets and then multiplied by one thousand:

$$\Delta E[ISSUE|X] = \hat{\beta}_j \times \Phi(X\hat{\beta}/\hat{\sigma}) \times \hat{\sigma}_{X_j} \times \overline{ASSETS}, \quad j = 1..n. \tag{6}$$

Both the standard deviation of the independent variables in question and total assets $\overline{ASSETS} = exp(\overline{lnA})$ are provided in Tables 1 and 2.

Table 4 summarizes some of the selected partial effects. As can be seen, a single standard-deviation shock to gross impaired non-mortgage loans was found to have reduced average issuance by $24 million (for the full 1994 domestic subsample, including the five foreign bank subsidiaries) to $55 million for a Big Five bank. This would reduce mean issuance by at least a third to one-half, well within a single standard-deviation of $\overline{ISSUE}$.[39] Likewise for the 1994 sample, domestic banks are sensitive to shock to mortgage writeoffs. A single standard-deviation shock caused mean issuance to drop by $32 million.

The most dramatic effect was on non-mortgage loans 90 days past due but still accruing interest. A standard-deviation increase in this was found to increase average issuance for a domestic bank by $236 million, but only by $139 million for a Big Five bank. This suggests

[39] The distribution for issuance is, however, right-skewed, since a single standard-deviation drop in issuance implies a negative value.

that domestic banks respond to an increased potential for loan losses by issuing SD. This is further supported by the estimated effects that a one-standard-deviation increase in leverage has on the bank's issuance. The effect is positive, suggesting again that SD, under the right market conditions, is a form of cheap capital.

7.3 Market value and publicly traded banks

As noted earlier, the measure LEV relies on an assumption of perfect correlation between the market value of common shares and the book value of common shares plus retained earnings. This is a poor proxy. For instance, in the 1994 sample, market value net worth and book value net worth are shown to be highly correlated (0.953); however, both are trending variables, and so any relationship between the two could be spurious. As soon as either value is measured as part of a leverage ratio, the correlation between book value leverage and market value leverage drops (0.244).

To correct this deficiency, a new variable ($MKTLEV_{it}$) is constructed that measures the market value of common shares plus the book value of preferred shares relative to the total book value of assets. In order to measure the market value of common shares, the bank has to have issued common stock. The only banks that issued common stock were the eight domestic banks in the sample from 1994. The additional domestic banks in the 1998 sample have not issued common stock.[40] Likewise, during the sample period, foreign bank subsidiaries were exempt under the Bank Act from issuing common stock.[41] The same Tobit estimation methodology was applied, including $MKLEV_{it}$ with LEV_{it}. In addition, the XT sample was updated to the most recently reported quarter (2004Q4) with the help of SEDAR. Tables 5 and 6 summarize the results for domestic public banks and the Big Five banks for the three Tobit specifications.

The results suggest that there is generally a weak positive relationship between increases in the market value of leverage and the issuance decision of the bank. When a bank experienced an increase in market leverage it was more likely to issue SD. MKLEV is a measure of the corporate structure of the firm. A firm that is highly leveraged should ultimately find it difficult to issue debt securities without facing an increase in the cost of capital. This suggests that as leverage increases, ultimately an economic constraint binds, leading to a negative relationship between leverage and the issuance of SD. Here, however, the opposite sign was observed, which suggests that a second effect is dominating. Namely, the firm is finding itself leveraged, and needs to raise funds (possibly as a capital substitute), so it chooses to issue SD. If there is no binding economic constraint, then SD can be a cheap source of capital for a bank. Conversely, as a bank becomes less leveraged, it has less need

[40] Manulife Bank is a wholly owned subsidiary of Manulife Insurance Company and was not required under the 1992 Bank Act to issue publicly listed common stock. The same holds for Citizens Bank, which is a wholly owned subsidiary of Van City Credit Union.

[41] As long as they stayed below $750 million in equity prior to Bill C-8 (2001) and below $1 billion afterwards, they were not required to issue common stock. If they met this threshold, they could still seek permission from the Minister of Finance to be exempt. HSBC Canada appears to be an example of this exemption process. It passed $1 billion in equity in 1999, yet does not issue common shares.

Table 5: Tobit Estimates of Factors that Affect Issuance Decision of a Publicly Owned Domestic Bank: 1994Q2-2004Q4

	Full $N = 8$			Big 5 $N = 5$		
	FE	Pooled	RE	FE	Pooled	RE
GIMPNMA	-0.2572^{***}	-0.2527^{***}	-0.0470^{**}	-0.1839^{***}	-0.1711^{***}	-0.0457^{**}
	(0.0996)	(0.0732)	(0.0219)	(0.0695)	(0.0591)	(0.0218)
WRITMA	-6.0541^{***}	-6.6437^{***}	-1.4090^{***}	-2.0617	-2.7384	$-.2797$
	(2.4419)	(2.3323)	(0.5492)	(4.7773)	(4.4113)	(1.5580)
MKLEV	$1.1E-04$	$-3.6E-05$	$-1.2E-05$	$8.5E-05$	$-4.4E-05$	$-4.9E-05$
	$(1.5E-04)$	$(8.9E-05)$	$(2.8E-05)$	$(1.2E-04)$	$(9.7E-05)$	$(3.9E-05)$
ROA	0.2711	-0.0072	0.0488	-0.0495	-0.2280	-0.0396
	(0.4542)	(0.3566)	(0.1132)	(0.2900)	(0.2328)	(0.0953)
LNA	-0.0013	-0.00006	-0.0002^{***}	0.0003	-0.0003	0.0003
	(0.0021)	(0.0002)	(0.0001)	(0.0013)	(0.0011)	(0.0004)
ISSUE_{t-1}	-0.0921	-0.0309	-0.0349	0.0807	0.1415	0.0327
	(0.2025)	(0.1981)	(0.0567)	(0.1692)	(0.1651)	(0.0728)
ILLIQ	0.0001	-0.0008	-0.0001	0.0001	-0.0004	-0.0003
	(0.0012)	(0.0012)	(0.0004)	(0.0007)	(0.0007)	(0.0003)
VIX	$-3.5E-06$	$-1.4E-05$	$-3.5E-06$	$-4.9E-05$	$-4.9E-05$	$-8.1E-06$
	$(9.0E-05)$	$(8.7E-05)$	(0.00003)	$(5.6E-05)$	$(5.4E-05)$	$(2.1E-05)$
TSE	0.0012	0.0008	0.0005	0.0008	0.0007	0.0005
	(0.0013)	(0.0013)	(0.0004)	(0.0008)	(0.0008)	(0.0003)
UR	0.0010^{*}	0.0015^{***}	0.0003^{**}	0.0007^{**}	0.0008^{**}	0.0004^{***}
	(0.0006)	(0.0004)	(0.00013)	(0.0004)	(0.0003)	(0.0001)
$ln\mathcal{L}$	298.059	291.733	1629.445	313.698	308.808	1136.112
NT	336	336	336	210	210	210
σ	0.0045	0.0045	0.0019	0.0022	0.0022	0.0011
$\Phi(X\hat{\beta}/\hat{\sigma})$	0.261			0.354		

Notes: Standard errors are in parentheses. * represents significance at the 10 per cent level, ** at the 5 per cent level, and *** at the 1 per cent level. $\Phi(z)$ represents the cumulative standardized normal distribution, evaluated at z. Controls are $ILLIQ$, VIX, TSE, and UR. Quarterly and Bank dummy estimates are suppressed.

Table 6: Tobit Estimates of Factors that Affect Issuance Decision of a Publicly Owned Domestic Bank: 1997Q1-2004Q4

	Full $N = 8$			Big 5 $N = 5$		
	FE	Pooled	RE	FE	Pooled	RE
GIMPNMA	-0.6250^{**}	-0.7454^{***}	-0.1213^{**}	-0.1612	-0.3027^{**}	-0.0218
	(0.2465)	(0.1948)	(0.0541)	(0.1667)	(0.1391)	(0.0561)
WRITMA	-8.1065^{**}	-11.182^{**}	-2.3971^{***}	-6.0424	-9.2665	-1.4798
	(3.9628)	(4.6408)	(0.7980)	(9.1543)	(9.1419)	(2.9433)
NMLA90A	7.1031^{***}	3.3233^{***}	1.0821^{***}	2.9426^{**}	1.1174	0.3779
	(1.6504)	(1.0641)	(0.3218)	(1.4055)	(0.7645)	(0.3208)
OREOA	-1.4531	-0.1289	-0.7086^{**}	-1.8345	-0.9225	-0.7812
	(1.1411)	(1.0603)	(0.3449)	(1.5451)	(1.5293)	(0.6103)
MKLEV	$5.6E-04^{**}$	$1.4E-05$	$-3.3E-05$	$1.3E-04$	$-5.2E-05$	$-3.0E-05$
	$(2.2^{E}-04)$	$(1.2E-04)$	$(3.7E-05)$	$(1.6E-04)$	$(1.4E-04)$	$(5.9E-05)$
ROA	0.7486	-0.2377	0.0360	0.1827	-0.2857	0.1141
	(0.4801)	(0.4140)	(0.1271)	(0.3410)	(0.3032)	(0.1382)
LNA	0.0002	-0.0001	-0.0003^{***}	-0.0012	-0.0002	-0.0008
	(0.0029)	(0.0003)	(0.0001)	(0.0018)	(0.0015)	(0.0007)
ISSUE_{t-1}	-0.1160	0.1669	-0.0135	0.0073	0.2540	-0.0053
	(0.2167)	(0.2230)	(0.0638)	(0.1980)	(0.1966)	(0.0901)
ILLIQ	0.0012	-0.0012	-0.0005	0.0006	-0.0006	-0.0004
	(0.0014)	(0.0014)	(0.0005)	(0.0009)	(0.0009)	(0.0004)
VIX	-0.00016	-0.00001	-0.00001	-0.00012	-0.00004	-0.00003
	(0.00012)	(0.00011)	(0.00003)	(0.00008)	(0.00008)	(0.00003)
TSE	-0.0003	0.0005	0.0003	-0.0002	0.0003	0.0001
	(0.0014)	(0.0015)	(0.0005)	(0.0009)	(0.0009)	(0.0004)
UR	0.0012^{*}	0.0016^{***}	0.0006^{***}	0.0009^{*}	0.0011^{***}	0.0005^{***}
	(0.0006)	(0.0005)	(0.0002)	(0.0005)	(0.0004)	(0.00016)
$ln\mathcal{L}$	227.865	210.542	1245.437	228.360	218.243	861.302
NT	256	256	256	160	160	160
$\hat{\sigma}$	0.0041	0.0045	0.0019	0.0022	0.0023	0.0011
$\Phi(X\hat{\beta}/\hat{\sigma})$	0.250	–	–	0.337	–	–

Notes: Standard errors are in parentheses. * represents significance at the 10 per cent level, ** at the 5 per cent level, and *** at the 1 per cent level. $\Phi(z)$ represents the cumulative standardized normal distribution, evaluated at z. Controls are $ILLIQ$, VIX, TSE, and UR. Quarterly and Bank dummy estimates are suppressed.

to raise capital, and thus does not issue SD. This is consistent with the general downward trend in SD outstanding over the past decade.

The results changed moderately for the Big Five banks. Note that, in the 1997–2004 Big Five sample (Table 6), NMLA90A is positive and significant, which suggests that the Big Five banks are inclined to increase SD issuance in response to increases in their past-due loans. Given the lack of significant variables that help explain the behaviour of the Big Five banks in the recent past, this stands out as important. Although issuance decisions are generally invariant to signs of weakness on the bank's balance sheet, the forward-looking internal measure of future weakness further suggests 'timing' behaviour.

7.4 Robustness

For any panel-data model, there is a debate as to whether one should control for fixed or random effects. The literature suggests that random effects are appropriate whenever the cross-section is randomly sampled, and no preliminary intuition or guidance exists about patterns of unobserved heterogeneity in the data. Instead, fixed effects are more appropriate for this XT sample, since it is difficult to argue that these banks were randomly drawn. Differencing is not possible under Tobit, which implies that bank dummies are the only option for sweeping out fixed effects. The method of estimation used above is described by Baltagi (2001) for a linear model as least squares dummy variable (LSDV) estimation. The problem with this technique is bias in parameter estimates for samples with small T when $N \to \infty$. This is known as the incidental parameters problem, first documented by Neyman and Scott (1948). As the number of dummy variables approaches infinity, this impacts severely on the degrees of freedom of test statistics.

For completeness, Table 7 summarizes the results of Tobit estimation with random effects. The most notable feature in this table is that the null hypothesis, which posits that the random-effects contribution to overall variance is zero, cannot be rejected in all but the 1998 subsample of domestic banks. This suggests that there is no benefit from sweeping out random effects and that instead one can rely on pooled Tobit estimates to make inferences. With respect to the 1998 domestic subsample, results appear similar to both the pooled and fixed-effect Tobit estimates.

In this paper's sample, N is relatively small and T much larger, so including bank-specific dummies will only reduce degrees of freedom by $N - 1$ in an NT sample. Recently, Greene (2004) has examined the problem of bias in Tobit models with fixed effects. Monte Carlo simulations show that the incidental parameters problem disappears for $T \geq 10$, since the bias in slope estimates is less than 1 per cent from population values. However, estimates of the population variance remain biased downwards as group size increases. To determine whether fixed effects are present, the estimation procedure is duplicated for a pooled Tobit model. Table 8 reports the results; in this specification, each observation is treated as an independent draw from an identical distribution. In other words, for specification (1) $\omega = v_i = 0, \forall i$, which implies that the observations on each variable can be stacked into an $NT \times 1$ vector. Estimated coefficients, in general, are quite similar to the fixed-effects Tobit estimates. The only change is that LNA is positive and significant for both of the full

Table 7: Tobit Random-Effects Estimates of Factors Affecting Issuance

	Full (94) $N = 14$	Domestic (94) $N = 8$	Big 5(94) $N = 5$	Full (98) $N = 28$	Domestic (98) $N = 10$	Big 5(98) $N = 5$
GIMPNMA	-0.07000^{***}	-0.0383^{*}	-0.0542^{**}	-0.0011	-0.1045	-0.0800^{*}
	(0.0224)	(0.0215)	(0.0231)	(0.0017)	(0.0743)	(0.0469)
WRITMA	-1.3534	0.1855	-1.8093	-0.1887	0.0339	1.1461
	(1.2727)	(0.5478)	(1.6212)	(0.4629)	(0.6720)	(3.0574)
LEV	-0.00002	0.00002	0.00003	0.0005^{***}	0.0003^{**}	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
NMLA90A				0.0062	2.065^{***}	0.5037^{*}
				(0.0250)	(0.4266)	(0.2622)
OREOA				-0.0717	-2.4210^{***}	-0.2085
				(0.0833)	(0.6837)	(1.0421)
ROA	0.0043	0.0564	-0.0233	0.00003	0.2168	-0.0051
	(0.0174)	(0.0777)	(0.06400)	(0.0001)	(0.1370)	(0.1132)
LNA	-0.0001	-0.0003^{***}	-0.0001	-0.00004	0.0006	0.0004
	(0.0001)	(0.0001)	(0.0005)	(0.00004)	(0.0002)	(0.0006)
$ISSUE_{t-1}$	-0.0510	-0.0386	0.0152	0.0492	-0.0723	0.1533
	(0.0467)	(0.0568)	(0.0766)	(0.0408)	(0.0679)	(0.0971)
ILLIQ	0.0001	0.0013^{***}	0.0003	0.0004	0.001^{**}	0.0008^{**}
	(0.0008)	(0.0004)	(0.0003)	(0.0003)	(0.0005)	(0.0004)
VIX	-0.0001	-0.0001^{*}	-0.00002	$-3.9E-06$	-0.0001^{*}	-0.00002
	(0.0001)	(0.00003)	(0.00002)	(0.00002)	(0.00003)	(0.00002)
TSE	-0.0001	-0.00001	-0.0001	0.0002	0.0003	0.00001
	(0.0008)	(0.0004)	(0.00002)	(0.0002)	(0.0004)	(0.0003)
UR	0.0006^{*}	0.0001	0.0002	-0.0003	0.0001	-0.0010
	(0.0003)	(0.0001)	(0.0001)	(0.0002)	(0.0003)	(0.0002)
$\hat{\sigma}_\epsilon$	0.0051	0.0019	0.0011	0.0018	0.0019	0.0009
$\hat{\sigma}_v$	0.000	0.000	0.00	0.0001	0.0013	0.000
$LRT\sigma_v = 0$	$\chi^2_1 = 0.00$	$\chi^2_1 = 0.00$	$\chi^2_1 = 0.00$	$\chi^2_1 = 0.26$	$\chi^2_1 = 8.60^{***}$	$\chi^2_1 = 0.00$
$ln\mathcal{L}$	2007.537	1545.667	1072.138	3441.631	1155.951	676.585
NT	520	320	200	728	260	130

Notes: Standard errors are in parentheses. * represents significance at the 10 per cent level, ** at the 5 per cent level, and *** at the 1 per cent level. Controls are $ILLIQ$, VIX, TSE, and UR. Quarterly dummy estimates are suppressed. Hypothesis test $LRT\sigma_v = 0$ is a test for random effects. $Ho: \hat{\sigma}_v = 0$, no random effects.

samples and the domestic 1998 sample. This provides evidence that there is a size barrier associated with accessing SD markets. Only among the Big Five banks is there invariance to size changes and SD issuance.

To test for the presence of fixed effects, the log-likelihood functions are compared under the Tobit estimate with bank-specific dummies versus the pooled Tobit estimator. Table 9 summarizes likelihood-ratio tests of the significance of fixed effects in each of the subsamples. The null hypothesis is $\theta_1 = \theta_2 = ... = \theta_{N-1} = 0$ (or no fixed effects). If this joint hypothesis is rejected, then fixed effects are significant. For the full samples, fewer than $N-1$ dummies are included, since several foreign bank subsidiaries did not issue SD during the entire time span covered. The dummy variable is thus a perfect predictor of Y and is dropped from the estimation.[42] Results in all but one subsample suggest that controlling for fixed effects is important.

8. Conclusions

This paper summarizes the current regulatory and market framework for SD in Canada. It reviews the key features of SD, as a mechanism for market discipline, and explains why it is an important issue to consider going forward. First, SD holders have incentives to monitor banks' activities; given the limited upside associated with these investments, they wish to avoid exposure by selling or demanding a sufficiently high-risk premium to compensate for expected losses. Likewise, SD can be an effective complement to prudential supervision of larger banks that are capable of accessing the market but are also expected to use an Internal Ratings-Based approach. If the supervisor's role is to validate disclosed measurements, there is a risk that these measures may lag the actual performance of the bank. Information in SD markets, both in terms of issuance decisions and prices, provides a more forward-looking indicator of future market conditions and risks faced by a bank.

This study also reviews the current level of research and established (along with proposed) policies in other countries for the use of SD in prudential supervision. Several facts in Canada are common with the global theatre: the market is actively utilized by the larger banks worldwide, and the issuance and term-to-maturity decisions are affected by incentives to use SD as a cheap substitute for equity. Consequently, banks tend to issue infrequently and in large denominations, with a minimum maturity of 10 years. The effects are most noticeable for the smaller banks, for which these features can act as barriers. The secondary markets for SD tend to be very thin beyond the largest 15 banks in the United States.

Canadian SD markets have similar characteristics. There is little evidence of secondary market activity, even for the larger banks, and the primary market is dominated by the Big Five banks. Although the evidence suggests that SD is becoming less popular among banks (its share of liabilities has been dropping since 1996), this may simply reflect the current regulatory regime governing the use of SD in risk-based capital requirements. Likewise, given a minimum of five years' maturity, upon issuance, along with the international evidence

[42] Likewise, the N^{th} dummy variable is also dropped, since the restriction $\sum_{i=1}^{N} \theta_i = 1$ eliminates one degree of freedom.

Table 8: Tobit Pooled Estimates of Factors that Affect Issuance Decision

	Full (94) $N = 14$	Domestic (94) $N = 8$	Big 5(94) $N = 5$	Full (98) $N = 28$	Domestic (98) $N = 10$	Big 5(98) $N = 5$
GIMPNMA	-0.8385^{***}	-0.2704^{***}	-0.1879^{***}	-0.0135	-0.8834^{***}	-0.3506^{**}
	(0.1873)	(0.0753)	(0.0638)	(0.0277)	(0.2753)	(0.1440)
WRITMA	-12.4451^{**}	-6.7650^{***}	-1.8093	-2.1653	-3.0383	-3.1879
	(6.0334)	(2.2342)	(4.5868)	(4.3794)	(3.2400)	(10.6939)
LEV	0.0002	0.00002	0.0001	0.0005^{***}	0.0002	0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0002)	(0.0002)
NMLA90A				-0.3202	4.5010^{***}	41.6097^{***}
				(0.6527)	(1.4473)	(0.7433)
OREOA				-1.502	-0.3453	1.9535
				(1.8042)	(2.7539)	(2.3975)
ROA	0.0570	0.0131	-0.0672	-0.0038	-0.6902^{*}	-0.3248
	(0.0764)	(0.2607)	(0.1558)	(0.0129)	(0.3999)	(0.2090)
LNA	0.0020^{***}	-0.00001	-0.0008	0.0008^{**}	0.0007^{**}	0.0016
	(0.0006)	(0.0003)	(0.0012)	(0.0003)	(0.0004)	(0.0016)
ISSUE_{t-1}	-0.3780	-0.0667	0.1277	0.3396	0.3944	0.5220^{**}
	(0.3723)	(0.1987)	(0.1681)	(0.2623)	(0.2494)	(0.2306)
ILLIQ	0.0032	0.0025^{**}	0.0006	0.0033^{*}	0.0048^{***}	0.0021^{**}
	(0.0024)	(0.0010)	(0.0006)	(0.0017)	(0.0017)	(0.0009)
VIX	-0.0007^{***}	-0.0002^{**}	-0.0001	-0.0001	-0.0001	-0.00003
	(0.0003)	(0.00001)	(0.00006)	(0.0002)	(0.0002)	(0.0001)
TSE	-0.0036	-0.0009	0.0007	0.0009	0.0013	0.0002
	(0.0036)	(0.0013)	(0.0008)	(0.0022)	(0.0019)	(0.0008)
UR	0.0035^{***}	0.0035^{***}	0.0006	-0.0017	-0.0010	-0.0010
	(0.0011)	(0.0011)	(0.0004)	(0.0014)	(0.0013)	(0.0006)
$ln\mathcal{L}$	202.312	286.271	297.589	145.593	154.147	159.370
NT	520	320	200	728	260	130
$\hat{\sigma}$	0.0131	0.0044	0.0022	0.0080	0.0054	0.0019

Notes: Standard errors are in parentheses. * represents significance at the 10 per cent level, ** at the 5 per cent level, and *** at the 1 per cent level. Controls are $ILLIQ$, VIX, TSE, and UR. Quarterly dummy estimates are suppressed.

Table 9: Tests for No Fixed Effects. $N-1$ non-zero restrictions. $*$ denotes samples using $MKLEV$. $H_0: \theta_1 = \theta_2 = ... = \theta_{N-1} = 0$.

Sample	$F_{N-1,(N-1)T-K}$	p-value
1994 Full	$F_{11,496} = 1.83^{**}$	0.0473
1994 Domestic	$F_{7,300} = 1.76^{*}$	0.0955
1994 Big 5	$F_{4,183} = 2.33^{*}$	0.0579
1994 Domestic 8*	$F_{7,316} = 1.63$	0.1251
1994 Big 5*	$F_{4,193} = 2.19^{*}$	0.0720
1998 Full	$F_{15,666} = 1.84^{**}$	0.0284
1998 Domestic	$F_{9,226} = 3.77^{***}$	0.0002
1998 Big 5	$F_{4,106} = 3.54^{***}$	0.0094
1997 Domestic 8*	$F_{7,234} = 3.96^{***}$	0.0004
1997 Big 5*	$F_{4,141} = 4.27^{***}$	0.0027

that size is an important determinant of participation (when issuance is voluntary), this market may simply be inaccessible to smaller domestic banks and foreign bank subsidiaries. Unfortunately, herein lies the disconnect. Supervisors, in general, are predisposed towards longer maturity assets being used as capital; however, this makes it more costly for the smaller banks to use SD as a capital source. Since smaller banks cannot issue frequently, it is unlikely that SD could act as a uniform source of market discipline for all banks.

For the larger banks, the empirical evidence is weak as to whether they are affected by internal default risk measures. In the past, they avoided issuing SD whenever there was a high level of gross impaired non-mortgage loans or mortgage writeoffs relative to assets in the previous quarter. Since 1998, however, there has been little explanatory power in these default risk measures.

Smaller domestic banks, when they choose to issue, show stronger evidence of 'timing.' Their issuance decisions are also negatively affected by impaired non-mortgage loans or recent writeoffs of mortgage loans. Meanwhile, there is a positive relationship between anticipated future impaired loans and SD issuance for domestic banks. Domestic banks may be attempting to raise capital before increases in past-due loans lead to such loans being declared impaired. Only for the foreign bank subsidiaries is there a lack of evidence of any relationship between default risk and issuance decisions.

Smaller domestic banks appear to respond to increased leverage (either book value or market value) with increased SD issuance. This suggests that the regulatory (and not economic) capital constraint is binding. It is the only constraint that can be consistent with a positive relationship between leverage and SD issuance. The implication of a binding regulatory capital constraint is that banks have an incentive to engage in arbitraging the rules in order to align actual with economic capital requirements.

On the whole, this paper has shown that smaller domestic banks attempt to time their issuance decisions to avoid higher capital costs. A reduction in SD issuance when the 'perceived' default risk of the bank increases provides indirect evidence that markets do not

believe an implicit government guarantee exists. Otherwise, the issuance decisions would be invariant to the relative size of gross impaired loans and past-due loans. Consequently, the presence of market discipline in SD markets for these smaller domestic banks cannot be rejected. However this conclusion is found to be less convincing for the Big Five domestic banks. Although increases in gross impaired non-mortgage loans are found to significantly reduce SD issuance for the Big Five banks over the entire 10-year period, this relationship is much weaker after 1997. Likewise, other measures that might suggest timing behaviour by the Big Five banks are found to have an insignificant effect on issuance decisions. Therefore, there does not appear to be strong evidence for market discipline in the SD issuance decisions of the larger banks. This is unfortunate, since these are, ideally, the type of banks where a supervisor could benefit from additional support.

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Appendix A: Variables Used

The dependent variable is $ISSA_{it}$, which measures the amount of SD issued relative to total assets for bank i in period t. Samples consist of quarterly observations for banks for: (i) 1994Q1 to 2004Q1; and (ii) 1998Q1 to 2004Q1. Explanatory variables that affect the bank's decision come from the previous quarter and are defined as follows:

$GIMPNMA$: the ratio of gross impaired non-mortgage loans to total assets.

$WRITMA$: the ratio of mortgage loan writeoffs to total assets.

LEV: the ratio of total assets to net worth.

$MKLEV$: the ratio of market value of common stock plus book value of preferred shares to total assets.

$NMLA90A$: the ratio of non-mortgage loans past 90 days due still accruing interest to total assets.

$OREOA$: the ratio of carrying amount of foreclosed real estate and other assets owned to total assets.

ROA: the ratio of net income to total assets.

LNA: the natural logarithm of total assets.

$ISSA_{t-1}$: the total amount of SD relative to total assets issued last quarter.

$ILLIQ$: the difference between bid and ask spread on 90-day Government of Canada treasury bills.

TSE: the net return on the TSE300 index above an equivalent 90-day Government of Canada treasury bill.

UR: the unemployment rate.

VIX: the average closing value of the Chicago Board of Options Exchange volatility index

$B_1, B_2, ..., B_{28}$: Bank dummies.

DU: Foreign bank subsidiary dummy.

$FRACTION$: total number of periods banks issued SD divided by nT.

Appendix B: Banks Included in this Study

The following banks and foreign bank subsidiaries were tracked:

1994 Domestics Bank of Montreal, Bank of Nova Scotia, Canadian Imperial Bank of Commerce, Canadian Western Bank, Laurentian Bank, Nationale Bank, Royal Bank of Canada, and Toronto-Dominion Bank.

1994 Foreign Bank Subsidiaries HSBC Bank Canada, JPM Bank, Bank of Korea, Mizuho Bank, Sumito Bank, and Tokyo-Mitsubishi Bank.

1998 Additional Domestics Citizens Bank and Manulife Bank.

1998 Additional Foreign Bank Subsidiaries ABN AMRO, American Express Bank, Bank of China, Bank of East Asia, Tokyo-Mitsubishi Bank, Bank One, BCP Paribas, BNP, Citibank Canada, ING Bank, International Cathay Bank, J.P. Morgan Bank, Bank of Greece, and UBS.

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